# Watercourse Crossings

## Descriptions

For the purpose of this BMP, structures which cross creeks, streams, ponds, or other surface areas of running or open water are defined as watercourse crossings. Watercourse crossings are typically used to provide a more confined, safer, and environmentally sensitive means for crossing from one side of a watercourse to the other.

Watercourse crossings may be either above or below the water surface. The type of crossing may vary with respect to length, width, height, and construction design, depending on the purpose of the crossing and the environmental and physical characteristics of the watercourse.

All watercourse crossings require a permit from the Michigan Department of Natural Resources and the local soil erosion enforcing agency, and some may require permits from the U.S. Army Corps of Engineers or the Michigan Department of Transportation (MDOT). Crossing a county or inter-county drain requires a permit from the drain commissioner or inter-county drain board, as well as the MDOT.

## Other Terms Used to Describe

Bridges (Bridge Crossings)
Culverts (Culvert Crossings)
Stream Crossing
Temporary Crossing
Utility Crossing
Wetland Crossings are discussed in the Wetlands Crossing BMP

## Pollutants Controlled and Impacts

Confining and consolidating watercourse crossings to less sensitive areas eliminates random crossings and allows greater protection of the water resource.

## Application

Land Use
Transportation, recreation areas, golf courses.

Soil/Topography/Climate
Methods of installation and materials for the crossing will vary depending on the soils, topography, and climatic conditions during installation and throughout the expectant life of the crossing. Because the chemical and physical attributes of the soils may shorten the life expectancy of certain materials when they are placed underground or when the materials are periodically saturated, it is important to use soil tests or soil survey books or soil tests to determine the suitability of the soils for the structures being considered.

When to Apply

Watercourse crossings are used when there is a dependency for their use at a given location and when there are no other feasible and prudent alternatives to accessing the desired location without the use of a crossing.

Construction should be restricted to periods of low water levels when impacts to aquatic resources within the watercourse can be minimized. State permit conditions may restrict installation during time periods critical to various aquatic life (i.e. fish migrations, spawning, etc.).

Where to Apply

Apply in areas where there is a dependency for the crossing, where there are no other feasible and prudent alternatives, where impacts to the resources associated with the watercourse are minimal, and where adjacent wetland and watercourse resources would be adversely impacted if a bridge or culvert were not installed. See attached Exhibits for typical installation methods.

## Relationship With Other BMPs

Construction of some watercourse crossings may require using a cofferdam and Dewatering to work "in the dry." The areas around bridges and culverts may need to be stabilized using Slope/Shoreline Stabilization structures.

The areas up-slope and adjacent to the crossings should be stabilized using Seeding, Sodding, Mulching, Critical Area Stabilization and other appropriate BMPs.

## Specifications

Note: **All watercourse crossings should be designed by registered professional engineers.**

**Planning Considerations for All Watercourse Crossings:**

The following are general items to consider during the planning of any watercourse crossing. Specific items for each type of crossing follow.

1. Perform a site evaluation to determine where the crossing should be located. Site selection should consider:

   -Using areas which would provide minimal impact to wetlands, floodplains, floodways, sensitive areas, or protected species associated with the watercourse. Check the list of known occurrences of threatened and endangered species--available at MDNR, Wildlife Division.

   -Using areas where the potential for erosion of the disturbed land cover is minimal.

   -Using areas where clearing and disturbance of surrounding vegetative cover can be minimized.

-Avoiding areas where the watercourse bends.

-Avoiding stretches with the highest velocity.

2. Determine the type of structure needed. There are basically two types of structures--above-ground structures and below-ground structures. Above-ground structures include culverts and bridges. Below-ground structures include the pipelines and utilities.

3. Determine the soil textures at the selected site. The soil survey maps produced by the Soil Conservation Service include information on the suitability of each soil type for various types of structures. Make sure the soil type will support the structure you are proposing.

4. Design the structure, following the general guidelines below. The design of all watercourse crossings should be done by licensed professional engineers.

**Permanent Below-Ground Crossings:**
Utility crossings, cables and/or pipelines are all possible methods of below-ground crossings. The specifications listed directly below apply to below-ground crossings. See Exhibits 1-4

Planning Considerations for Below-Ground Crossings:

1. The MDNR prefers the use of drilling and boring utility lines over the plow-in and trenching methods. Drilling and boring reduces the likelihood of erosion, as well as disturbance of the banks and bottom substrates which typically occurs with both the plow-in and trenching methods.

2. Localize utility crossings to one location, and/or encase several utilities into one casing.

3. If a utility line cannot be bored or drilled under the watercourse, the plow-in method should be used, where possible. A "dry run" with the plow is usually done prior to attaching the cable or pipe to clear out any possible stumps, logs, or other obstructions.

4. If the open-trench method must be used, consider constructing a Sediment Basin downstream to collect sediment during construction.

5. Backfill all excavated substrates from a utility crossing with clean, washed fieldstone or clean, washed gravel.

Construction Considerations for Below-Ground Crossings:
The construction of underground utilities should be done in one operation to minimize the impacts on the environment. To do this, follow the guidelines below and refer to Exhibits 1-4.

1. Bring both sides of the utility within 10 feet of the crossing on either side. The ten-foot unexcavated area should remain as such until both sides are within 10 feet and until the rest of the crossing process occurs.

2. When using the trenching method, install a temporary Sediment Basin downstream to collect sediment from the project area, or follow the procedures in Exhibit 3 to construct a flume so that work can be done "in the dry."

3. For the trenching method, dig out the remainder of the fill area to excavate the trench.

   Note that the depth to which the utility pipe should be laid is dependent upon the waterbody which is being crossed. For example, on county and inter-county drains, you may be required to maintain 3 to 5 feet below the last established bottom elevation, depending on the requirements of the drain commissioner or the inter-county drain board. A minimum of 3 feet of cover should be maintained at all locations.

4. Backfill, as needed, with washed stone or gravel, according to the design. You may use the original material if it is not erodible.

5. Upon completion of the project, Sediment Basins should be filled and stabilized or converted into a stormwater basin. Follow specifications in the Sediment Basin BMP.

6. Stabilize the up-slope area with vegetation following the Seeding and Mulching or Sodding BMPs. Consider using Diversions to divert runoff from the project area.

**Permanent Above-Ground Crossings:**

Culverts and bridges are the two primary means of crossing a watercourse above-ground. The Department of Natural Resources recommends the following structures, in order of preference.

1. Clear span bridge
2. Multi-span bridge
3. Single box, arch or pipe culvert
4. Multiple box, arch or pipe culvert

Clear-span bridges are preferred for crossing a watercourse over other methods because they can provide adequate hydraulic capacity without restricting normal or above normal flows within a watercourse. Other types of structures, including multi-span bridges and culverts, tend to restrict or obstruct the normal flow of a watercourse via their related fill materials or support pilings, by reducing the area in which the watercourse normally would flow. These restrictions typically lead to increased erosion both upstream and downstream of the structures, collection of debris on these structures, and possible navigational hazards. These structures also cover up and reduce the amount of natural bottom substrate available as habitat.

Above-ground crossings can be made of timber, concrete or metal. In areas designated as Natural Rivers the applicant may be required to soften the aesthetic impact of the material used. See the Appendices for the list of Natural Rivers in Michigan.

**Note on Wood Preservatives:** There are three classes of common timber treatment: creosote, pentachlorophenol, and inorganic arsenicals. These "preservatives" are restricted use pesticides. Lumber treated with these products is allowable for use in direct incidental contact with surface water uses as drinking water supplies.

The Department does not recommend the use of creosote and pentachlorophenol due to the leachability, persistence, bioaccumulation and hazards of their constituents. The Department supports the use of inorganic arsenicals for use in watercourse crossings.

General Considerations for All Above-Ground Crossings:

1. A flood flow analysis should be done for all types of above-ground crossings and are required under Act 167 for drainage areas greater than 2 square miles.

2. Consider using existing (old) crossings and existing (old) grades instead of creating new crossings.

3. Roadway approach fills should be minimized in temporary crossings and must be removed after use.

4. Consider installing devices along the roadway itself to control runoff from the roadway. These devices can include Grade Stabilization Structures and water turnouts, both of which are discussed under "Bridges: Design," below.

5. Adequate vegetative cover must be established on all disturbed areas upon completion of finish grading.

**Bridges:**

Planning Considerations for Bridges:

1. Obtain hydraulic clearances from the Land and Water Management Division.

   -Locate the structure at the narrowest point in the floodplain/wetland.

   -Indicate any alterations or reconstruction that is needed in the channel to accommodate the proposed structure.

   -For bridges which will be used as part of a roadway, indicate how stormwater runoff from the roadway will be managed to prevent erosive velocities. Alternatives are discussed below in number 6.

2. A cofferdam may be used to create a dry work site, or water may be flumed or pumped around the work site. Follow specifications in the Dewatering BMP.

3. Consider installing a sediment trap downstream of the road crossing if filter fences, floatation curtains, cofferdams and other practices won't be able to keep soil from moving downstream. These are temporary in-stream basins which will only be used to trap excess sediment from this particular project. Once the project is completed, the sediment basin will be removed and the channel bottom restored. You will need a permit from the MDNR, Land and Water Management Division for any in-stream sediment basin.

4. Disruption of the natural vegetation should be kept to a minimum.

5. Avoid the use of pentachlorophenol-treated wood in timber bridges. Use inorganic arsenicals.

Design Considerations:

1. Bridge crossings (including bridges and roadways) must be designed to pass the 100-year flood flow without causing a harmful interference, as determined by the MDNR, Land and Water Management Division.

2. Bridge abutments should be parallel to the direction of flow. Exceptions may occur during the engineering review as a result of flood flow direction.

3. The bridge should span the entire width of the stream, leaving the stream bed beneath the structure undisturbed. The vertical clearance should not obstruct wading, boating, or other types of free passage.

4. If cofferdams are used, locate them to isolate the construction work site from the stream flow. Alternatives include:

   -Constructing a temporary run around the channel
   -Pumping water around the site to provide a dry work site

   Follow proper Dewatering operations.

5. Riprap should be installed beneath bridges on all fill slopes or exposed banks. Follow specifications in the Riprap BMP.

6. Stormwater runoff from roadways should be directed away from the crossing using one of the methods below:

   a. Water turnouts. These are small chutes or depressions constructed on roadways to direct water to stabilized outlets. The stabilized outlets can consist of sod, or with higher velocities, rock or concrete. In sandy soils, excavations alongside the road may be adequate to retain water and allow it to percolate to the groundwater without running directly into the watercourse.

   b. Grade Stabilization Structures, which include down drains, pipe drop structures and chutes, can be used to take water from one elevation to the next, either above-ground or underground. GSSs can be used along roadways to take the water from the road to the watercourse, or to a stabilized area.

   c. Curb and gutter should only be used where it is absolutely necessary. The areas adjacent to the curb and gutter should be stabilized with seed or sod, and the outlets from the gutters should not be such that they cause erosive velocities.

   d. Concentrated runoff can be directed to a detention or retention basin and either released slowly to the watercourse or allowed to infiltrate the soil. Refer to one of the detention/retention BMPs for more guidance.

7. Provide stabilization of bridge abutments and all fill slopes using Riprap and other Critical Area Stabilization practices.

Construction Considerations:
The construction of a bridge should be done with the least amount of impact on the natural resources. To do this, the operation must be done in steps which will decrease the amount of water crossings that occur. Follow the guidelines below and refer to Exhibits 5-8 for permanent structures. See the section on "Temporary Above-Ground Crossings" for information on using bridges, culverts and other materials for temporary crossings.

1. Where depth allows, place filter fences in the water adjacent to the bridge abutment which will be removed first. If filter fences will not work in water because of water depth, consider using floatation curtains. These are suspended in the water and help settle out larger particles so that they are not carried downstream. Filter fences and floatation curtains are both discussed in the Filters BMP.

2. If flows or banks are such that filter fences cannot be used, consider using cofferdams alongside the channel.

3. Where applicable, install the approved sediment trap.

4. Where applicable, remove the first bridge abutment and replace with a new one.

5. Stabilize the first side with vegetation and riprap following the Riprap and Critical Area Stabilization BMPs.

6. Install riprap alongside the new abutment and on either side of the new abutment. Follow specifications in the Riprap BMP to determine the size stone needed, the filter required, and the installation procedures for riprap.

7. Place filter fences and/or floatation curtains on the opposite site and repeat the sequence above for the second side.

8. Complete the rest of the bridge using as few crossings with equipment as possible.

9. Clean out the sediment trap upon completion. Restore the natural channel bottom.

10. During construction, keep loose boards, nails and other debris on-site and in a way which will not result in them entering the waterway. Wash buckets, wheel barrows and shovels upland away from the water course.

**Culverts:**
Culverts may be permitted by the MDNR, drain commissioner or drain board where there is a shown dependency for the crossing, where the installation of a bridge is not a feasible and prudent alternative, and where aquatic impacts are minimal. The MDNR, Land and Water Management Division must be contacted regarding any culvert construction, repair, etc.

Planning Considerations:

1. Obtain hydraulic clearances from the MDNR, Land and Water Management Division.

2. The structure should be located at the narrowest point of the floodplain/wetland.

3. If the proposed crossing will require reconstructing or relocating the stream, you must contact the MDNR, Land and Water Management Division to obtain the necessary permit.

4. A cofferdam may be used to create a dry work site, or water may be flumed or pumped around the work site. Follow specifications in the Dewatering BMP.

5. A sediment trap may be required for installation downstream of the crossing prior to any other construction work. These are in-stream temporary basins which will only be used to trap excess sediment from this particular project. Once the project is completed, the sediment basin will be removed and the channel bottom restored. You will need a permit from the MDNR, Land and Water Management Division for any in-stream sediment basin.

6. Disruption of the natural vegetation must be kept to a minimum.

7. Consideration should be given to the amount of development occurring in the upstream reaches so that culverts can be sized to account for potential increases in flow.

Design Considerations:

1. Culverts and weir flow over the road must be designed to pass the 100-year flow of a watercourse with no harmful interferences, as determined by the MDNR, Land and Water Management Division.

2. The bottoms of these structures must be recessed to a depth based on the natural downcutting rate of the stream over the expected lifespan of the structure, or at least 12 inches below the existing streambed, if no data is available to support a deeper recess.

3. The diameter of the culvert should approximate the width of the watercourse. Stream width should not be changed.

4. The culvert should be installed so that it maintains the existing stream gradient.

5. The culvert must provide for proper road width and side slopes.

6. The culvert should not obstruct navigation if the watercourse is deemed navigable.

7. The use of multiple culverts is discouraged. If multiple culverts are needed then the design should be changed to a bridge.

Construction Considerations:

1. When depth allows, place filter fences in the water adjacent to the area in which the culvert will be placed or replaced. If filter fences will not work because of water depth, consider using floatation curtains. These are suspended in the water and help settle out larger particles so that they are not carried downstream. Filter fences and floatation curtains are

both discussed in the Filters BMP.

2. If flows or banks are such that filter fences cannot be used, consider using cofferdams along the channel.

3. Where approved, install an in-stream sediment trap downstream of the road crossing.

4. Remove the old culvert and install the new one. The new culvert should line up with the watercourse at both the inlet and outlet ends. Recess the culvert at least 12 inches into the bottom of the watercourse, or to the anticipated scour depth of the natural channel.

5. Backfill on either side of the culvert. Compact following the design.

6. Install riprap on all fill in contact with the watercourse, and a minimum of two rows on either side, or at least three feet above the ordinary high water mark. Follow specifications in the Riprap BMP to determine the size stone needed, the filter required, and the installation procedures for riprap.

7. Stabilize the area up-slope of the culvert with vegetation, following the Critical Area Stabilization BMP.

8. Clean out the in-stream sediment trap upon completion. Restore the natural channel bottom.

**Temporary Above-Ground Crossings:**
Temporary above-ground crossings are utilized to provide access for larger equipment for construction purposes, forestry operations and similar uses. These structures are removed upon completion of the needed work and the crossing is restored to its original condition. All temporary crossings require a permit from the MDNR.

Exhibits 9-11 include examples of three different types of temporary roads.

## Additional Considerations

**Safety:**
All structures should be free of protruding objects and sharp edges. Guard and hand rails should be installed, where appropriate. (See the Michigan Department of Transportation/OSHA Construction and Safety Manual).

Inadequately sized culverts have the potential to create strong suction at their upstream ends during peak flows, thus creating public safety hazards and liability concerns. They may also cause upstream flooding, as well as excessive velocities at the outlet.

## Maintenance

Maintenance of **culverts** should include inspections to determine if:

-piping has occurred around the culvert. Note any erosion adjacent to the culvert

-the culvert has collapsed or is otherwise inoperable
-the culvert is clogged or otherwise obstructed

These and any other problems should be addressed immediately. Failure of a culvert can severely impact surface waters and/or threaten the safety of people and structures downstream. Replace collapsed culverts. Stabilize eroded areas using vegetative BMPs. Do *not* dump new sediment and leave exposed soil. Remove debris which is clogging culverts.

**Bridge** maintenance should include checking the structural integrity of the structure and making sure the banks on either side are stabilized. Stabilize all exposed soils.

## Exhibits

Exhibit 1: Stream Crossing--Pipelines/Cables. MDNR, Land and Water Management Division, Bridge/Culvert Program.

Exhibit 2: Stream Crossing--Pipeline, Detail SC-1. Same as Exhibit 1.

Exhibit 3: Stream Crossing--Flume Construction, Detail SC-3. Same as Exhibit 1.

Exhibit 4: Stream Crossings--Pipelines/Cables, Detail SC-4. MDNR, Land and Water Management Division, Construction Project Evaluation Manual.

Exhibit 5: Bridges--Typical Bridge Placement, Detail B-1. Same as Exhibit 4.

Exhibit 6: Bridges--Typical Rip-Rap Section, Detail B-2. Same as Exhibit 4.

Exhibit 7: Culverts--Typical Culvert Sections and Placement, Details C-1 and C-2. Same as Exhibit 4.

Exhibit 8: Streambank Stabilization--Permanent Rip-Rap, Detail SBS-2. Same as Exhibit 1.

Exhibit 9: Stream Crossing--Temporary Haul Road, Detail SC-2. Same as Exhibit 1.

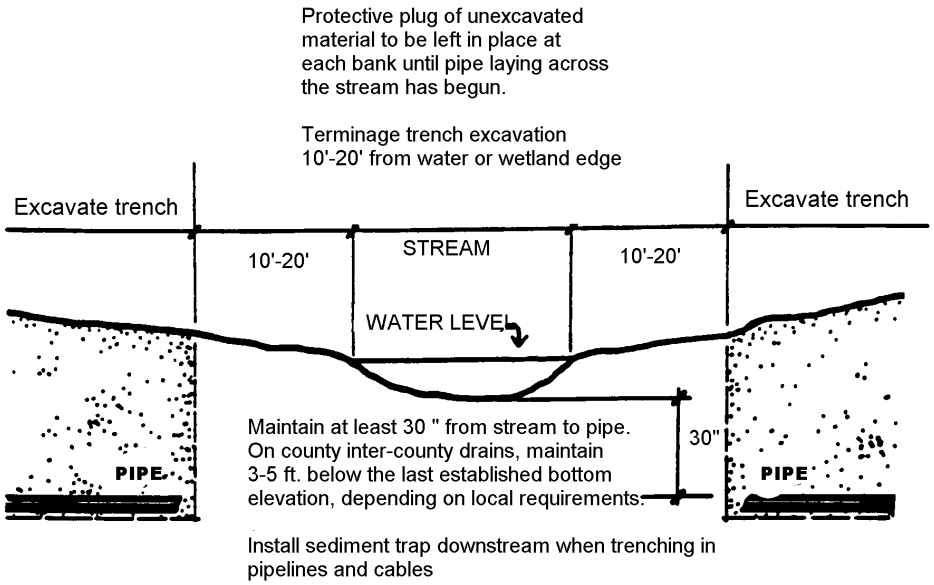
Exhibit 10: Temporary Stream Crossing--Culvert, Detail TSC-1. Same as Exhibit 4.

Exhibit 11: Temporary Stream Crossing--Preferred and Unacceptable, Detail TSC-2. Same as Exhibit 4.

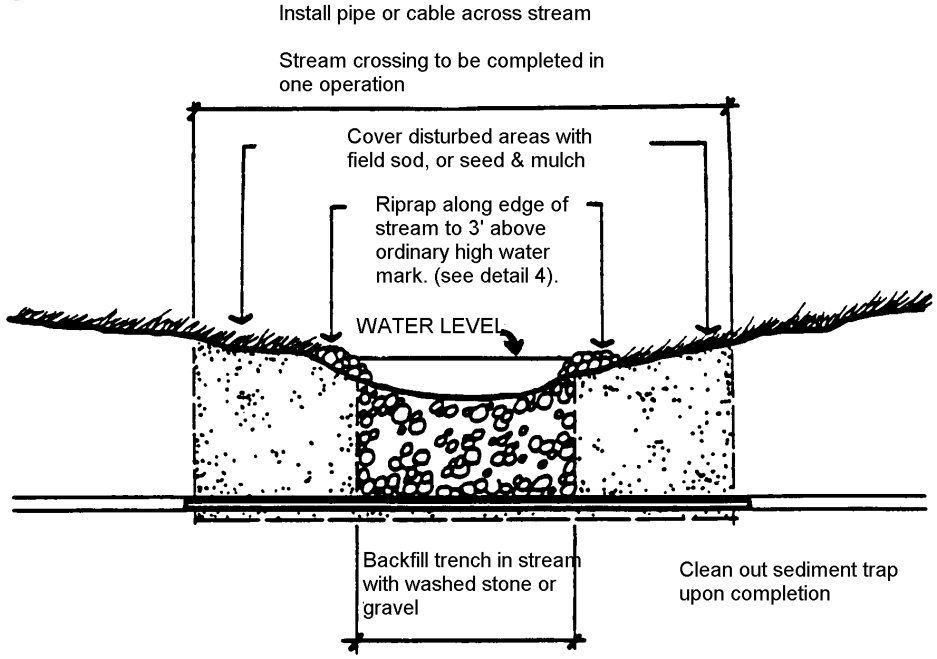
**Exhibit 1**

**Stream Crossing (Pipelines/Cable)**

## STEP ONE



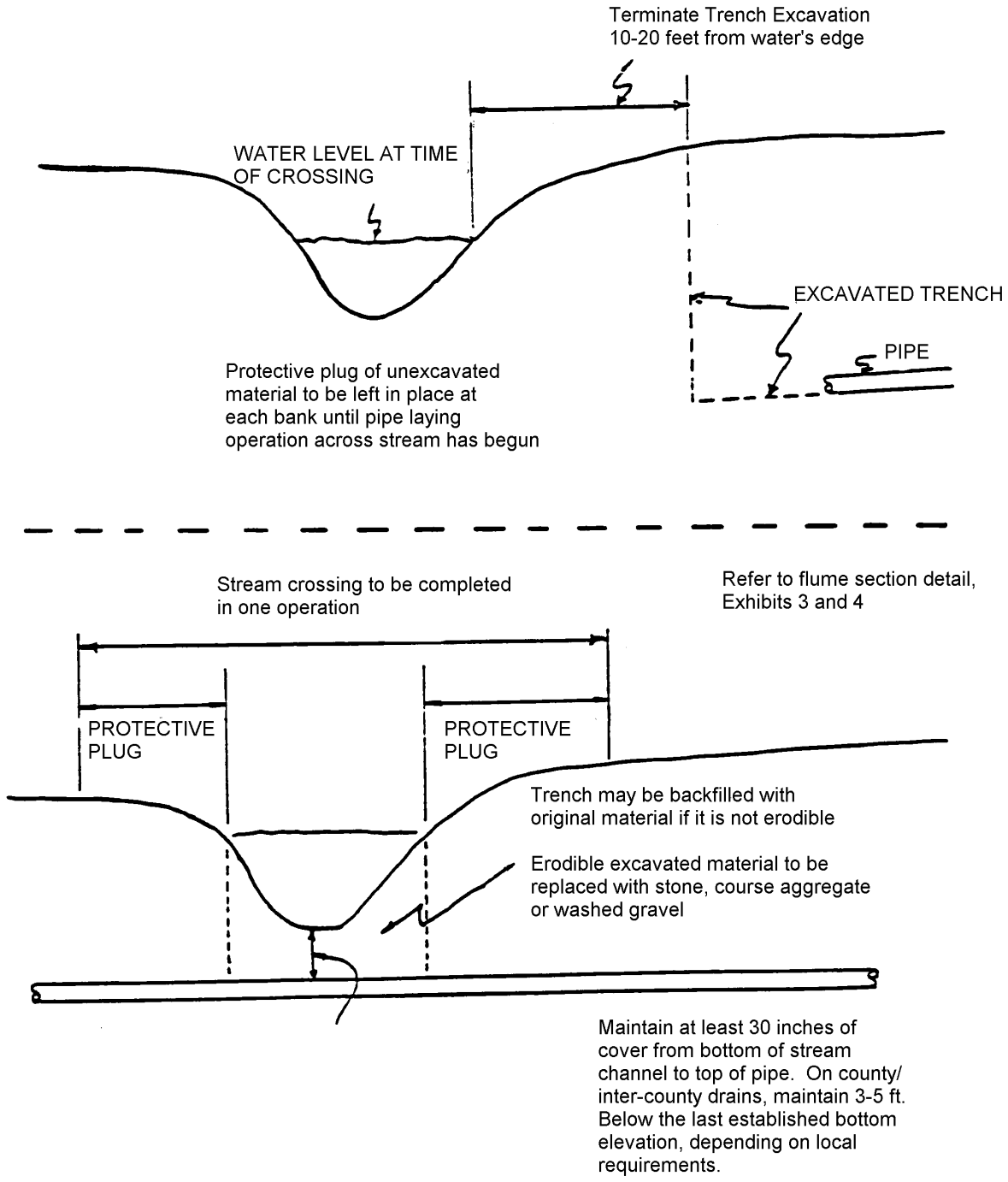

## STEP TWO




Source: Modified from Construction Project Evaluation Manual. MDNR, Land and Water Management Division.

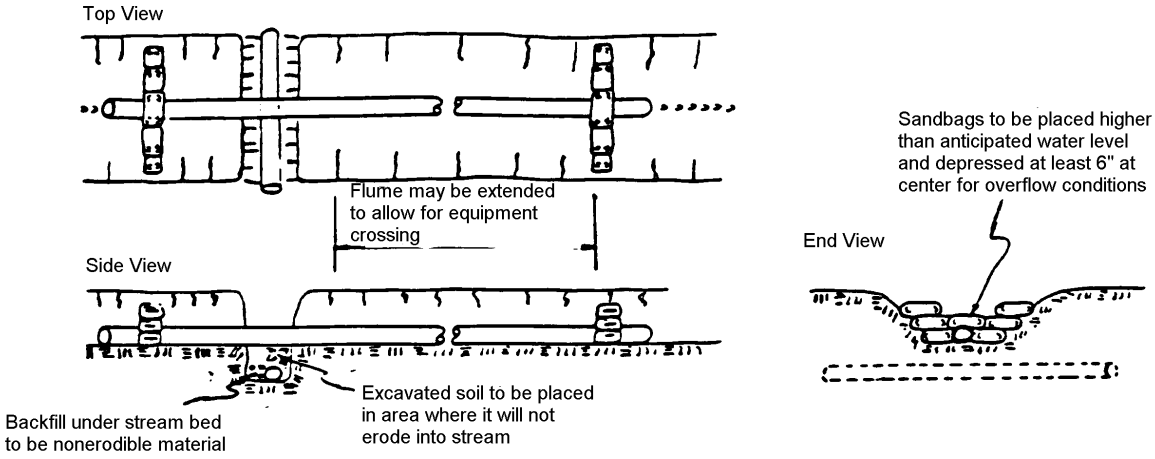
**Exhibit 2**

**Stream Crossing**
**Pipelines**




Source: Modified from Construction Project Evaluation Manual. MDNR, Land and Water Management Division.

**Exhibit 3**
**Stream Crossing**
**Flume Construction**




Notes: Contractor to notify department when crossing will be made. Notify drain commissioner if working in a county or inter-county drain.

Only sandbags will be used for damming unless other materials are approved by the department.

Sandbags to be filled no more than 75% capacity of the bag to allow effective stacking and molding of bags around flume.

Sediment control practices downstream of flume may be required subject to extent of stream disturbance caused by construction.

Sequence of Construction:

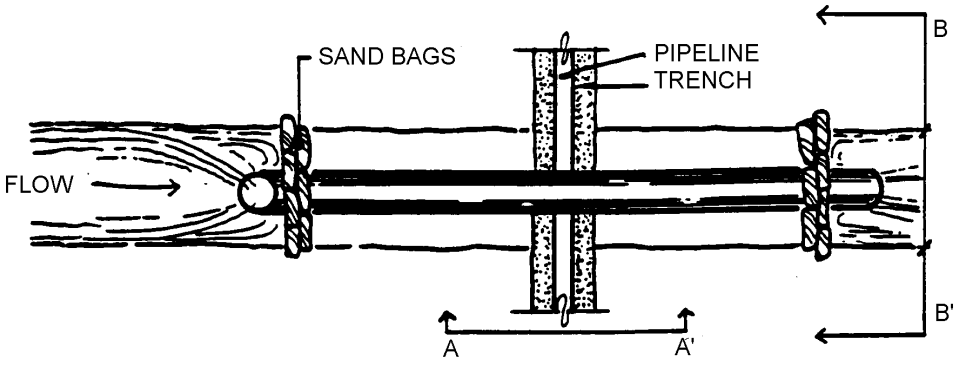
1. Lay flume along bottom of stream.
2. Place sandbags at upper end of flume and then at lower end of flume to lower water level.
3. Dewater crossing at discretion of contractor. Discharge water following Dewatering specifications.
4. Begin trenching and placement of pipe.

Sequence of Stabilization:

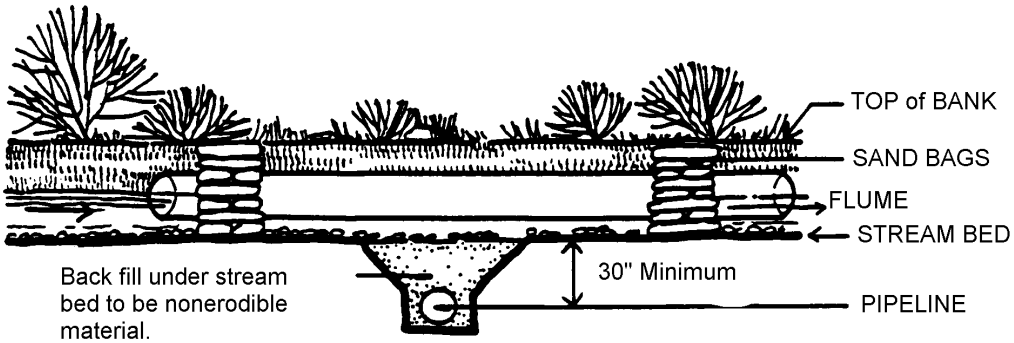
1. Backfill trench under stream bed with nonerodible material.
2. Stabilize disturbed stream banks and bed.
3. Remove sandbags. Dispose of in upland site.
4. Remove flume without disturbing bottom of stream.

Source: Modified from Construction Project Evaluation Manual. MDNR, Land and Water Management Division.

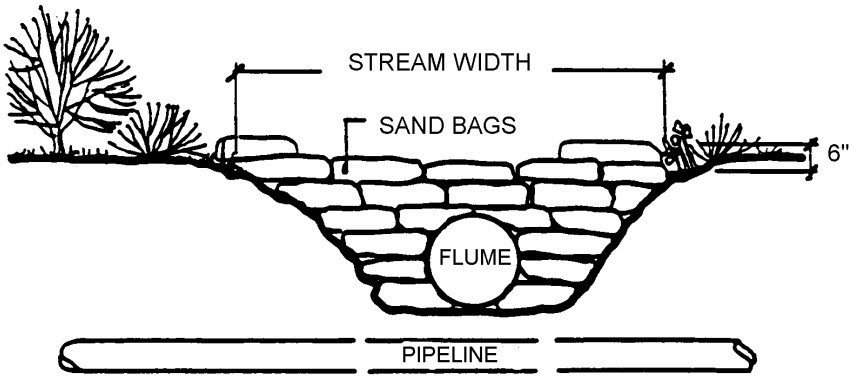
**Exhibit 4**
**Stream Crossings (Pipelines/Cable)**




FLUME PLAN VIEW



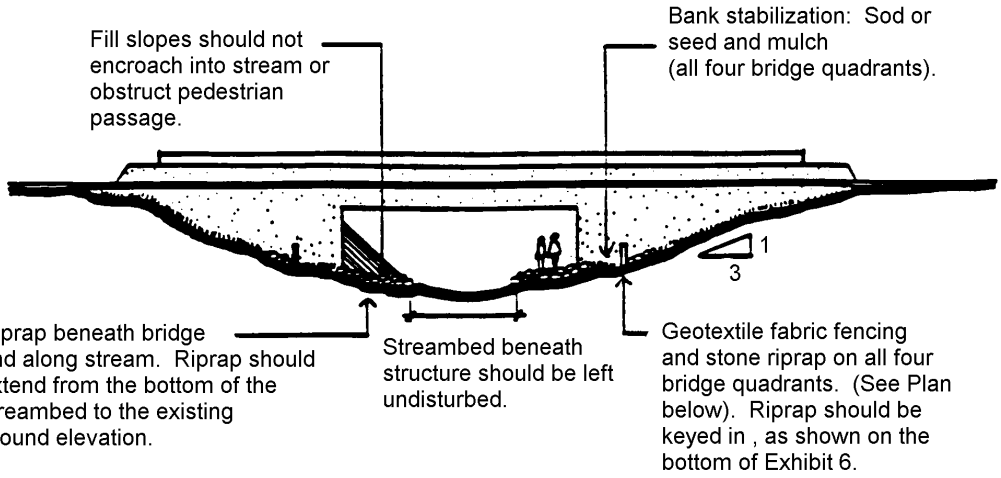

FLUME SECTION A-A'



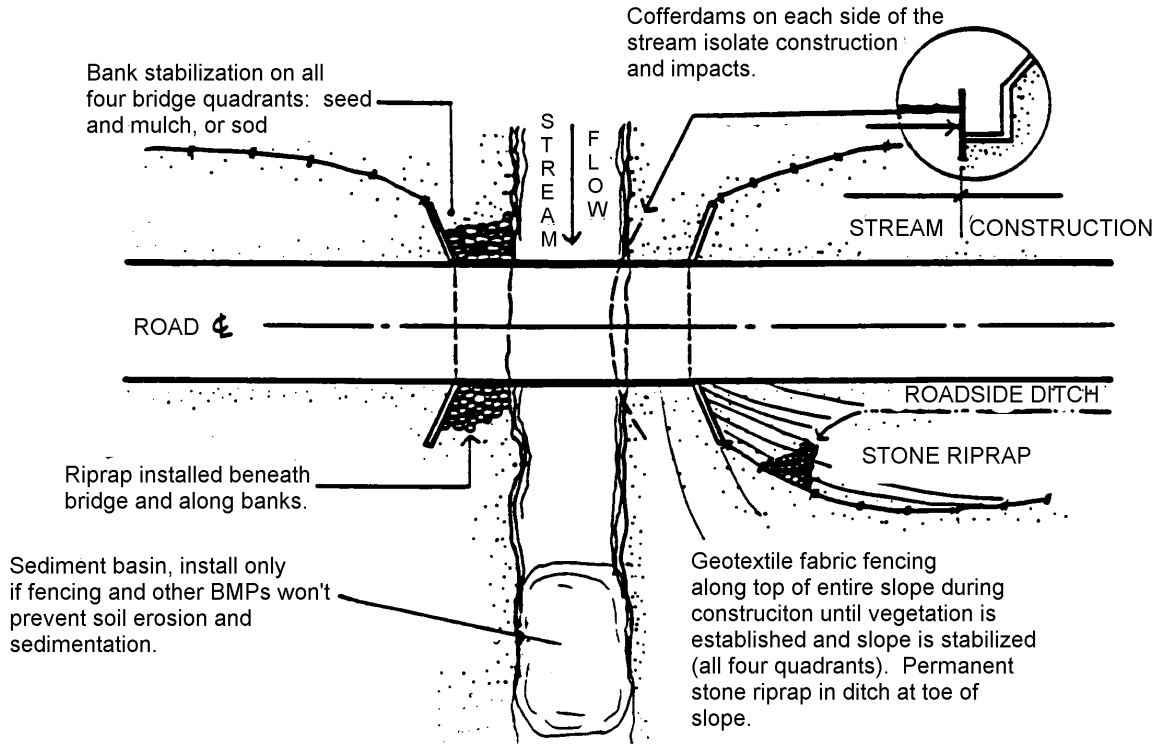

FLUME SECTION B-B'

Source: Modified from Construction Project Evaluation Manual. MDNR, Land and Water Management Division.

**Exhibit 5**
**Bridges**

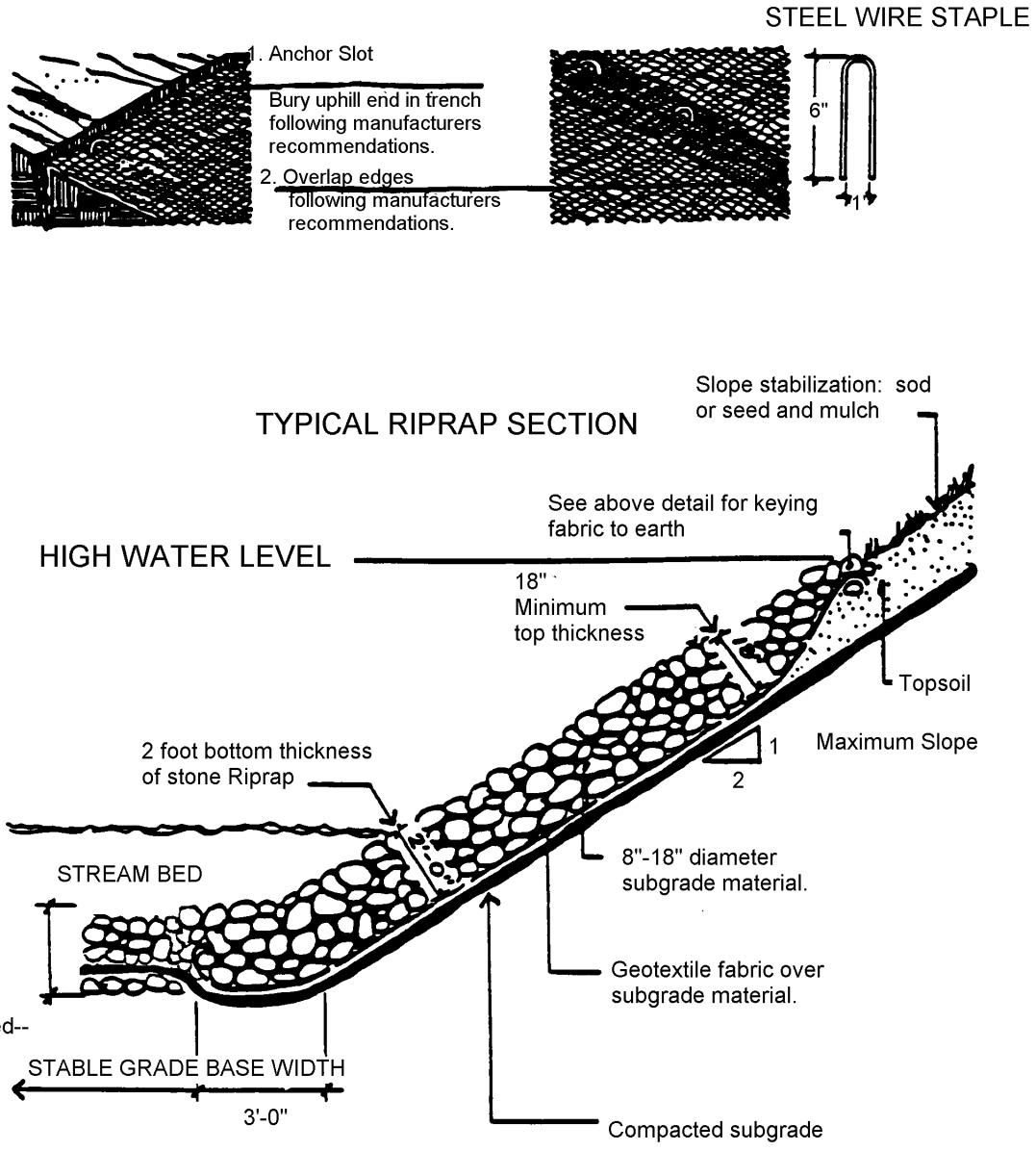



TYPICAL BRIDGE PLACEMENT




Source: Modified from Construction Project Evaluation Manual. MDNR, Land and Water Management Division.

**Exhibit 6**
**"Keying In" Filter Fabric**

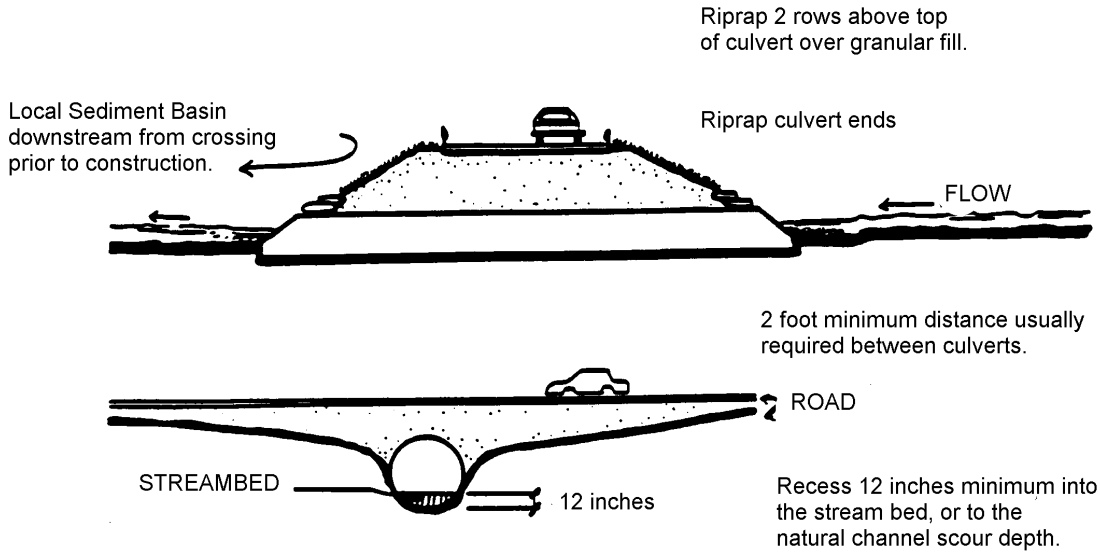



Source: Modified from Construction Project Evaluation Manual. MDNR, Land and Water Management Division.

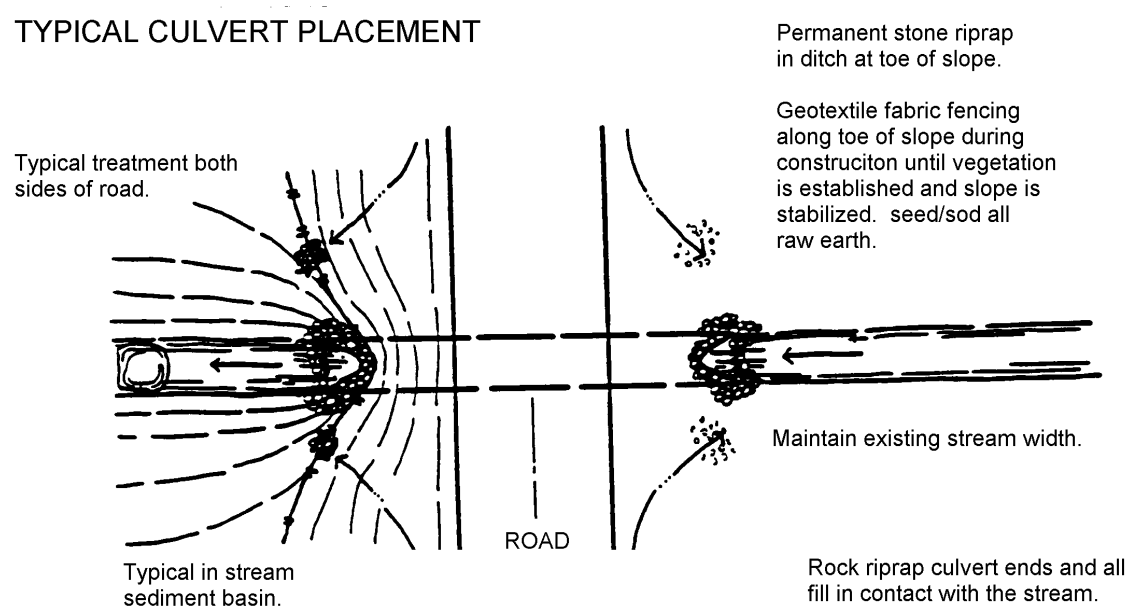
**Exhibit 7**

**Culverts**

Culvert length should allow for proper road width and shoulders, and gradual side slopes, 2:1 (horizontal: vertical) maximum.




TYPICAL CULVERT PLACEMENT



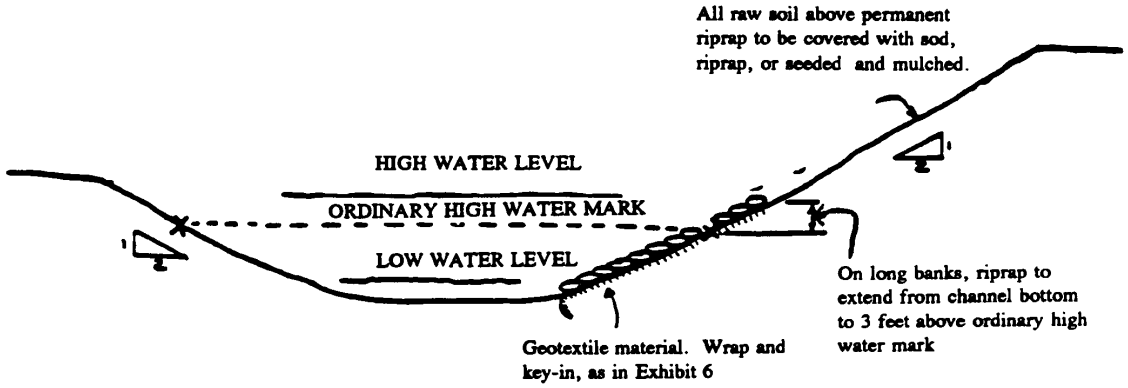

TYPICAL CULVERT PLACEMENT

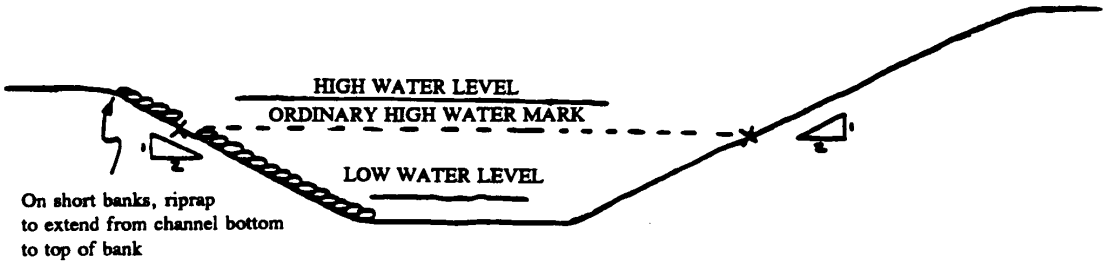
Source: Modified from Construction Project Evaluation Manual. MDNR, Land and Water Management Division.

**Exhibit 8**

**Streambank Stabilization:**

**Permanent Riprap**




Notes: Stream banks shall not be left unprotected for any period of time. Temporary or permanent protection must be applied immediately.

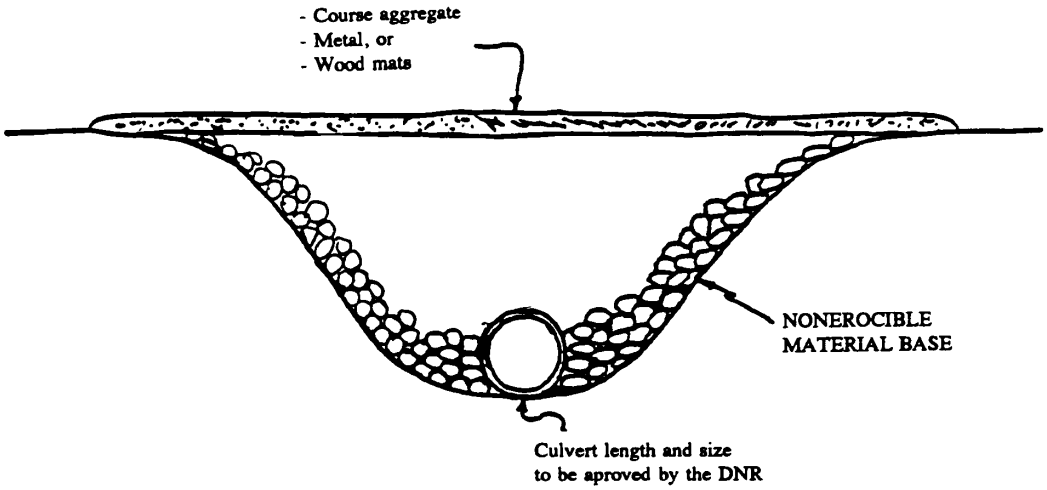
Riprap following Riprap specifications

Source: Modified from Construction Project Evaluation Manual. MDNR, Land and Water Management Division.

## Exhibit 9

## Temporary Haul Roads

Running surface materials should be placed on the surface, to a depth of 1 foot. The material should be capable of sustaining the anticipated load. Use:



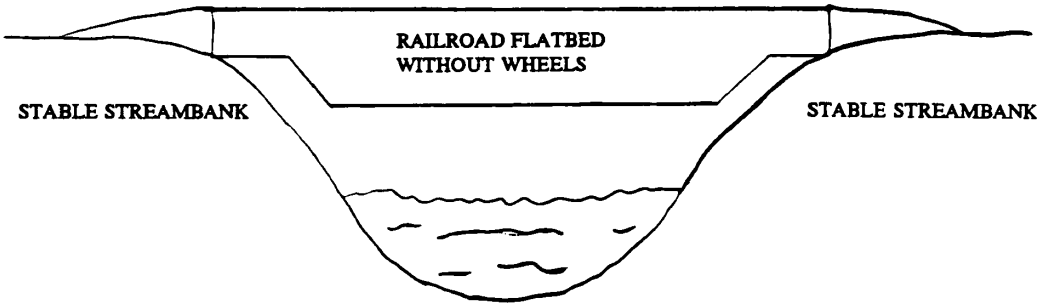

* Streambanks are to be left in a stable condition when temporary structures are removed.

* Construction and removal of temporary haul road may require sediment control measures downstream.

Other possible temporary crossings which may be used upon approval include:

* Crossings constructed with a culvert with snow packed around it. In the spring when the snow melts, the culvert is removed.

* Crossings constructed of a flatbed railroad with its wheels removed. This structure can be moved easily on logging trucks, etc.



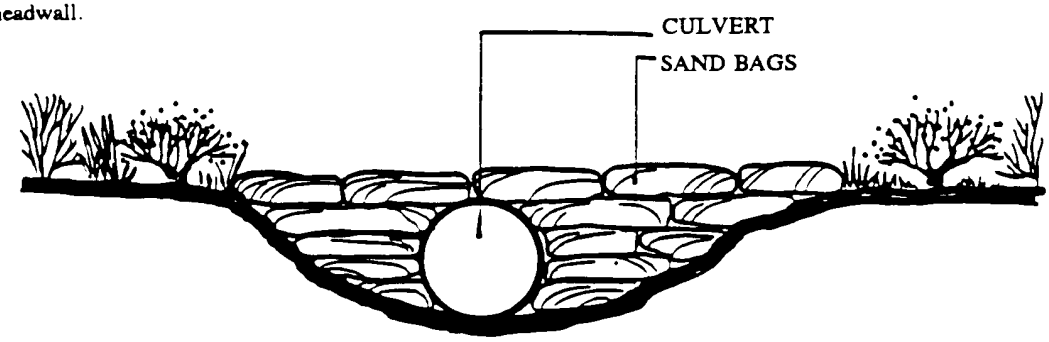

Source: Modified from Construction Project Evaluation Manual. MDNR, Land and Water Management Division.

## Exhibit 10

## Temporary Stream Crossing

Sand bags should be placed from the culvert ends to the streams bank. This will create a headwall.

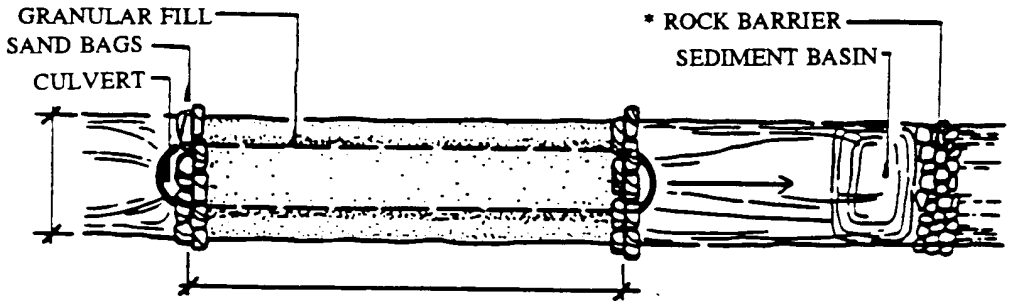
Stabilize stream bank when crossing is removed.




SECTION VIEW at Culvert End

Granular fill should be placed in layers and compacted, especially near culvert. When the culvert is removed, gravel-size particles and larger can be left on the stream bottom.

Typical in-stream sediment basin is 30' long by 4' deep by the width of the stream.




PLAN VIEW

*The rock barrier should be designed following specifications in the Check Dam BMP.

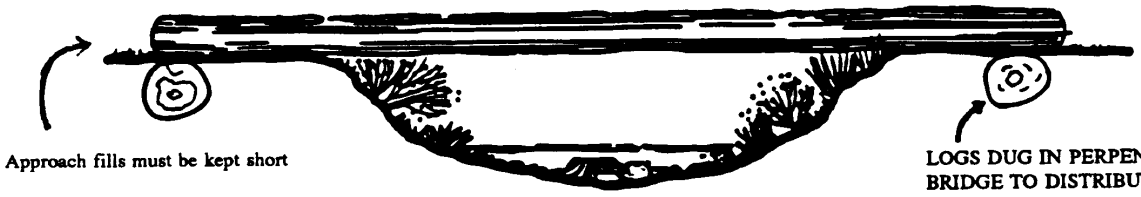
Source: Modified from Construction Project Evaluation Manual. MDNR, Land and Water Management Division.

## Exhibit 11

## Temporary Stream Crossing

AN IDEAL TEMPORARY CROSSING FOR MOST STREAMS WITH STABLE BANKS

TIMBER DECK WITH NO ABUTMENTS



Approach fills must be kept short

LOGS DUG IN PERPENDICULAR TO BRIDGE TO DISTRIBUTE WEIGHT

Erosion from excessive bank disturbances is minimized.

Stream banks are undistured. Revegetation of banks is minimal

Source: Modified from Construction Project Evaluation Manual. MDNR, Land and Water Management Division.